Amendments to the Claims

Listing of Claims

The following listing of claims supersedes all previously claims.

1. (Previously presented) A method for processing substrate to form a semiconductor device, said substrate including an etch stop layer disposed above a metal layer, comprising:

etching through said etch stop layer, using a plasma etch process that utilizes a chlorine-containing etchant source gas, thereby forming etch stop layer openings in said etch stop layer, said etch stop layer including at least one of a SiN and SiC material; ~~and~~

performing a de-ionized water rinse on said substrate; and

thereafter performing a wet treatment on said substrate, said wet treatment including a rinse using a solution that contains acetic acid (CH_3COOH).

2. (Original) The method of claim 1 wherein said metal layer represents a copper-containing metallization layer.

3. (Original) The method of claim 2 wherein said substrate further includes a dielectric layer disposed above said etch stop layer.

4. (Original) The method of claim 3 wherein a material of said dielectric layer has a dielectric constant of less than 4.

5. (Original) The method of claim 4 wherein said etching through said etch stop layer is performed through dielectric layer openings in said dielectric layer.

6. (Original) The method of claim 3 wherein said etching through said etch stop layer is performed through dielectric layer openings in said dielectric layer.

7. (Original) The method of claim 1 wherein said etch stop layer includes said SiC material.

8. (Original) The method of claim 1 wherein said solution further includes ammonium hydroxide (NH_4OH).

9. (Original) The method of claim 8 wherein said ammonium hydroxide concentration is between about 0.5% and about 10% by volume.

10. (Original) The method of claim 9 wherein said acetic acid concentration is between about 1% and about 99.5% by volume.

11. (Original) The method of claim 1 wherein said acetic acid concentration is between about 1% and about 99.5% by volume.

12. (Canceled)

13. (Previously presented) A method for performing a dual damascene process on a substrate, said substrate including a dielectric layer disposed above an etch stop layer, said etch stop layer being disposed above a metal layer, comprising:

performing plasma etching through said dielectric layer using a first etchant source gas to form a plurality of dielectric-layer openings;

performing plasma etching through said etch stop layer, using a second etchant source gas different from said first etchant source gas, said second etchant source gas including chlorine, thereby forming etch stop layer openings in said etch stop layer, said etch stop layer including at least one of a SiN and SiC material;

performing one of a de-ionized water rinse and a HCl dip/de-ionized water rinse on said substrate; and

thereafter performing a wet treatment on said substrate, said wet treatment including a rinse using a solution that contains acetic acid (CH_3COOH).

14. (Original) The method of claim 13 wherein said metal layer represents a copper-containing metallization layer.

15. (Original) The method of claim 14 wherein a material of said dielectric layer has a dielectric constant of less than 4.

16. (Original) The method of claim 15 wherein said etch stop layer includes said SiC material.

17. (Original) The method of claim 13 wherein said solution further includes ammonium hydroxide (NH_4OH).

18. (Original) The method of claim 17 wherein said ammonium hydroxide concentration is between about 0.5% and about 10% by volume.

19. (Original) The method of claim 18 wherein said acetic acid concentration is between about 0.5% and about 99.5% by volume.

20. (Original) The method of claim 13 wherein said acetic acid concentration is between about 1 % and about 99.7 % by volume.

21. (Canceled)

22. (Previously presented) The method of claim 13 wherein a material of said dielectric layer has a dielectric constant of less than 4.

23. (Canceled)

24. (Original) The method of claim 13 wherein said plasma etching through said etch stop layer is performed in a capacitively-coupled plasma processing system.

25. (Original) The method of claim 13 wherein said plasma etching through said etch stop layer is performed in an inductively-coupled plasma processing system.

26. (Currently amended) A method for processing substrate to form a semiconductor device, said substrate including an etch stop layer disposed above a metal layer, comprising:

etching through said etch stop layer, using a plasma etch process that utilizes a chlorine-containing etchant source gas, wherein said chlorine-containing etchant source gas includes an inert gas, said inert gas including at least one of Ar, He, Ne, Kr, and Xe, thereby forming etch stop layer openings in said etch stop layer, said etch stop layer including at least one of a SiN and SiC material;

performing a HCL solution dip on said substrate;

thereafter performing a rinse on said substrate, said rinse using a rinsing solution that includes de-ionized water; and

thereafter performing a H_2 plasma treatment on said substrate.

27. (Original) The method of claim 26 wherein said metal layer represents a copper-containing metallization layer.

28. (Original) The method of claim 27 wherein said substrate further includes a dielectric layer disposed above said etch stop layer.

29. (Original) The method of claim 28 wherein said etching through said etch stop layer is performed through dielectric openings in said dielectric layer.

30. (Original) The method of claim 28 wherein a material of said dielectric layer has a dielectric constant less than 4.

31 (Original) The method of claim 26 wherein said etch stop layer includes said SiC material.

32 (Canceled)

33 (Canceled)

34 (Original) The method of claim 26 wherein said plasma etching through said etch stop layer is performed in a capacitively-coupled plasma processing system.

35. (Original) The method of claim 26 wherein said plasma etching through said etch stop layer is performed in an inductively-coupled plasma processing system.

36. (Previously presented) A method for processing substrate to form a semiconductor device, said substrate including an etch stop layer disposed above a copper metal layer, comprising:

etching through said etch stop layer, using a plasma etch process that utilizes a chlorine-containing etchant source gas, thereby forming etch stop layer openings in said etch stop layer, said etch stop layer including at least one of a SiN and SiC material;

performing a wet chemical treatment on said substrate, said wet chemical treatment employing a solution that includes an organic acid or a mixture of an organic acid and a hydroxide; and

thereafter passivating said copper metal layer through said etch stop layer openings with a passivating solution that includes benzotriazole(BTA).

37. (Original) The method of claim 36 wherein said substrate further includes a dielectric layer disposed above said etch stop layer.

38. (Original) The method of claim 37 wherein a material of said dielectric layer has a dielectric constant less than 4.

39. (Original) The method of claim 37 wherein said etching through said etch stop layer is performed through dielectric layer openings in said dielectric layer.

40. (Original) The method of claim 39 wherein said etch stop layer includes said SiC material.

41. (Canceled)

42. (Previously presented) The method of claim 36 wherein said organic acid is an acetic acid.

43. (Previously presented) The method of claim 36 wherein said hydroxide is ammonium hydroxide.

44. (Previously presented) The method of claim 36 further including performing one of a de-ionized water rinse and a HCl dip/de-ionized water rinse on said substrate prior to said wet chemical treatment.

45. (Original) The method of claim 36 further including performing a H_2 plasma treatment on said substrate prior to said passivating.

Claims 46-48 (Withdrawn)

49. (Previously presented) A method for processing substrate to form a semiconductor device, said substrate including an etch stop layer disposed above a metal layer, comprising:

etching through said etch stop layer, using a plasma etch process that utilizes a chlorine-containing etchant source gas, thereby forming etch stop layer openings in said etch stop layer, said etch stop layer including at least one of a SiN and SiC material;

performing a HCL dip/de-ionized water rinse on said substrate; and

thereafter performing a wet treatment on said substrate, said wet treatment including a rinse using a solution that contains acetic acid (CH_3COOH).

50. (Previously presented) The method of claim 49 wherein said metal layer represents a copper-containing metallization layer.

51. (Previously presented) The method of claim 50 wherein said substrate further includes a dielectric layer disposed above said etch stop layer.

52. (Previously presented) The method of claim 51 wherein a material of said dielectric layer has a dielectric constant of less than 4.

53. (Previously presented) The method of claim 52 wherein said etching through said etch stop layer is performed through dielectric layer openings in said dielectric layer.

54. (Previously presented) The method of claim 51 wherein said etching through said etch stop layer is performed through dielectric layer openings in said dielectric layer.

55. (Previously presented) The method of claim 49 wherein said etch stop layer includes said SiC material.

56. (Previously presented) The method of claim 49 wherein said solution further includes ammonium hydroxide (NH_4OH).

57. (Previously presented) The method of claim 56 wherein said ammonium hydroxide concentration is between about 0.5 % and about 10% by volume.

58. (Previously presented) The method of claim 57 wherein said acetic acid concentration is between about 1 % and about 99.5% by volume.

59. (Previously presented) The method of claim 49 wherein said acetic acid concentration is between about 1 % and about 99.7% by volume.